106-30-40

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

KA

REPLY TO: 2620 Planning

SUBJECT: Project Review and Development of Preliminary Design of Hatchery Creek Enhancement Project

TO: Glen Contreras, Fish and Wildlife Program Manager

On Monday, November 17, 1980, an interagency meeting was held in Ketchikan. The objectives of this meeting were to:

1. Develop a preliminary design concept for improving the fish passage ability at the upper Hatchery Creek Falls. The resulting design concept would be subject to minor modifications at a later time but not the major changes as occurred with Logjam Creek.

2. Determine if the available geotechnical and survey information is adequate to pursue the design of a fish passage facility.

3. Is some data still outstanding that is necessary for design and if so, how should it be pursued?

A list of people attending this meeting is attached to this report.

Prior to the commencement of detailed discussions of the Hatchery Creek Project, a slide presentation was given by Area personnel. These slides displayed the general physical features of both falls sites at Hatchery Creek and specific details of the upper site at various stream stages. Winter time ice conditions were also displayed. These slides presented a useful focal point of discussion. Specilist reports on the hydrology and geo-tehcniques of Hatchery Creek were inspersed to those attending.

A quick review of the Fisheries Status Report for Hatchery Creek was presented by Mike Pease. Bob Dewey, RO, expressed concern about pink and chum salmon being suitable target species for enchancement in Hatchery Creek. If these species are designated as target species, then the design of a passage facility will be affected. It will also necessitate correction of the lower most falls at Hatchery Creek. The lower falls are considered a barrier to pink and chum at this time. However, there is considerable spawning habitat available in this lower section for pink, chum and other spcies. Don Siedelman, ADFG, agreed with Dewey but indicated that pink and chum salmon should be considered in the current design for potential future considereation. Dewey also expressed concern that this group should not let the tentative programmed funds distract our project vision. Future project funding may become limited, although $318,000 wa our tenative FY81 budget advice for the entire program.

A review of the hydrology of Hatchery Creek was presented by Louis Bartos. During the 1980 field season, attempts were made to install stilling well stream guage records on both Hatchery and Logjam Creeks. The Logjam station was destroyed by high flows and debris. High flows in Hatchery Creek prevented any installation. Next season, Bartos will install a sonic stream level recorder at Hatchery Creek.

Bartos stated that for Hatchery Creek, 100 year events that are commonly used in structural design produce flows of about 5,500-6,000 cfs. Hatchery Creek contains an extensive lake system that depress peak flows and maintain minimum flows on the hydrograph. These lakes cause responses to storm events to be slower as compared to the rapid and extreme responses at nearby Logjam Creek. Peak and minimum flows and projections of flow responses are based on application by Bartos and Orsborne from modifications of the Southeast Alaska Water Resources Altas. They express good confidence in the high flow values; less so about the low flows. Seven day low flows with a 2 year recurrance interval are predicted at about 45 cfs from the water atlas. However, Bartos feels it is about 25 cfs, however work done by Orsborn & Bartos indicate 30 cfs. A 30 day low flow with a 2 year recurrence interval is about 75 cfs.

A question was raised as to what low flow level the fish passage structure should be designed for? Contreras feels that it should be higher than the 25 cfs low flow. The group accepted the idea that some delay (for the entire basin) in fish passage can occur due to low flows. Siedelman stated that sockeye salmon generally are spawning in August and because of their early arrival in the system, some upstream migration delay can be tolerated. Such delay in holding can be incorporated into the low flow design. Another consideration was that it would be undesirable to divert the majority of the main channel by directing low flows into a fish passage structure. Such a situation is thought to be visually undesirable. Other limiting factors in adult fish migrating through the system will also be present at other sites.

The geothechinical information gathered at Hatchery Creek Falls during the 1980 field season was summarized by Asserude. Seven test drill holes were made at Hatchery Creek Falls. All holes were immediately at the falls or a short distance upstream. Drilling below the falls was not possible. The key points of this data area:

1. The rock strata that creates Hatchery Creek Falls is a narrow rock dike.

2. Upstream of this rock dike, overburden has accumulated to depths of 13 feet. This overburden is unconsolidated mixture of various types and sizes of materials.

3. The rock in the dike is extensively fractured but Charlie Clark's opinion is that it can be repaired in areas adjacent to a fish passage structure.

4. The existing rock can be modified by drilling and blasting.

5. Flow diversion walls can be built but will probably be difficult to hold in place.

6. Rock fractures have been located and are recorded in Clark's survey information which was unavailable for this meeting.

7. Additonal drill holes below the falls would have been desirable but could not be achieved.

A general discussion was held of the design criteria needed for a fish passage facility at Hatchery Creek. Fishway structures are normally designed to withstand a 100 year storm event. At such discharges, only structural considerations are important. Fish passage is not expected to occur during such events. Likewise, during periods of extreme low flow, fish passage at a structure is not expected. During such periods, many other areas and the stream itself could easily constitute barriers to fish passage. A suggested range of fish passage (Bartos), provided by a designed enhancement effort was between 50 and 400 cfs. At this time, the upper discharge value is quite arbitrary. Verification of this value will have to come from further detailed observations of adult fish attempting to negotiate the barrier. Application of this further information can be incorporated into a final project design at a later appropriate time.

An additional approach to determining the upper flow level for designed fish passage is to examine photographs of the site at various discharges and extrapolate this data to a topographic site map. Cross referencing with observations of successful fish passage could provide a suitable estimate of the upper flow level. The approach of migrating adults was discussed and pattern observed in the past indicated on maps. Holding, resting pools, attraction flows all were indicated on the map. Sockeye and coho were selected as the target species at this time.

During previous investigations of fisheries enhancement projects and opportunities in the Ketchikan Area, Orsborne has proposed a 3-phase approach to the design of an enhancement project. The concepts of this approach have been detailed in earlier reports by Orsborne. With specific reference to upper Hatchery Creek Falls, the minimal approach is to redue and modify the rock strata near the upper part of the falls (left bank looking downstream), and constructing an intermediate pool which fish can jump into. This approach would also modify the channel on the right side by creating some holes in the upper rock and placing appropriate material in the stream to raise the level of an intermediate pool. Some structural work would be required.

The moderate approach to project design would entail raising the water level of an intermediate pool on the right side by construction of a structural wall below the falls. The upper rock areas would be modified sufficiently to provide a controlled flow approach to the constructed pool.

A design approach calling for maximum improvement would be the construction of a fish passage facility that would guarantee passage of "weaker fish" over a wide range of flow conditions. Such a facility (fishway) would require flow controls at both inlet and outlet ends. Extensive structural design and rock modification would be required. Additional details of these three design approaches are presented as follows as suggested by Pete Klingeman:

Enchancement Level	Option Number	Opition Description	Guiding Criteria	Construction Difficulty
Minimum	1A	Blasting of left side, to improve pool structure	Assist coho & sockeye, two step jump	1 (Helicopter)
	1B	Blasting and steps on right side, to improve pool structure	Assist stronger fish (steeper with shorter steps)	3 (Helicopter)
	1C	Rock wall blanket on right side	Assist all strong fish	5 (Helicopter)

Enchancement Level	Option Number	Opition Description	Guiding Criteria	Construction Difficulty
Intermediate	2A	1C with tetrapods or gabions structure	Assist all strong fish	7
	2B	Concrete & rockwall & and spillway	Assists fish clearing the right side of falls	8
	2C	Concrete & rock chute with blocks (considered risky)	Assit stronger fish	8
	2D	Aluminum step pass or similar structure	(Not very feasible-problems in attraction flows)	8
Maximum	3A	Fish Ladder	Assits large numbers of fish	10 (15 if access and maintenance road is needed)

* Construction Difficulty was rated on a scale from 1-15 . Low values represent little or no major difficulties in construction, access, and trasportr of materials and equipment. Large values represent major difficulties in construction and access. A value of 15 represents the ultimate in investment of an access and maintenance road.

Lybrand asked about the status of the B/C for Hatchery Creek. This analysis has not been attempted yet. Contreras stated that it would be desirable to use a 1:1 economic analysis where anything above one is surplus benefit. This approach is not fully accepted by the Forest Service. All approaches to B/C analysis will have to occur once a design is completed. This will be coordinated between the SO and the RO wildlife staff.

Contreras stated that engineering capabilities can easily surpass the biological and habitat assessments. Therefore, going for a minimum activity initially can provide the opportunity for further assessment and evaluation of fish runs, critical flow levels, detailed structural design, and project cost analysis. Greater development can occur later if the need for such development exists. A Force Account approach may possibly be used to achieve this initial activity or independant construction contract.

A group concensus was that enchancement activity 1A would be the best to start with and possibly combine with 2A using gabion baskets as suggested by John Vaughn. Lybrand suggested that the Forest Service would probably want an inspection on site with an approved set of project plans during project implementation. The question who will design the project was raised. It appeared that a combination of Ketchikan Area specialists, Ben Pollard, ADFG, and Butch Wlaschin, RO, would help develop the design and coordinate with all areas. This project could serve as a pilot project while additional efforts continued for project assessment and evaluation at other sites.

Klingeman questioned what problem will bed load have on constructed downstream gabions. Orsborn and Bartos indicated that these structures would probably be flushed clean by high flows. This can be evaluated and included in the maintenance program.

A valid concern exists for Hatchery Creek is the development and coordination with ADFG of a meaningful monitoring and evaluation program. It is desirable to enumerate juvenile salmon in the rearing areas. An index of smolts produced above the falls would provide useful data with which to evaluate enhancement efforts. Input from Mike Haddix, ADFG, FRED Division, would be usefull for these tasks. Enumeration of adult salmon passing the barrier and their distribution on the spawning grounds would also be usefu.

During the 1981 field season, a Level IV stream survey of Hatchery Creek will be conducted. This will verifty the quantity, quality, and distribution of fish habitat in a standard format. Such survey data will be of value in long range planning.

Active project and program coordination must take place between the Forest Service and ADFG sport fish, commerical fish, habitat and FRED Divisions. Such coordination will assure that all issues and concerns are adequately addressed.

A final point to be considered is the potential impact of a fish passage structure on sport fisheries regulations. This also applies to a potential instream channel modification.

A copy of each specialist report is attached.

P. Michael Pease

P. MICHAEL PEASE
Fishery Biologist, SO

Enclosures

HATCHERY CREEK FISHWAY HYDROLOGIC STUDY

By: Louie Bartos - Hydrologist

INTRODUCTION

Hatchery Creek on Prince of Wales maintains an adequate run of coho and sockeye salmon up to the partial barrier which is located two miles upstream from its mouth at Sweetwater Lake. The construction of a fish ladder or pass is proposed to allow full utilization of the sizeable spawning and rearing areas above the falls.

The hydrologic base developed here is primarily used for designing, sizing, and evaluating structural elements such as intake evlevation and size, orientation, and sill size and orientation that are directly related to the fish ladder. This preliminary report was produced from field data and worked through synthetic procedures. After a second year of field date is obtained, the hydrologic and hydraulic base will be expanded and refined.

HYDRO-GEOMORPHOLOGY

The Hatchery Creek drainage is a relatively mature system as evidenced by its slightly meandering mainstem channel and gentle relief. The drainage area above the falls is 46.5 square miles. The mainstem channel has intermittent lakes caused by perpendicular, geologic controls that created natural sediment dams. Hatchery Creeks' shallow profile is graphically displayed by the elevation - distance plot shown in Graph 1. The stream's gradient results in an extended retention time during a period of precipitation - runoff.

The mean precipitation over the draingage is 115 inches per year, from 100 inches near the mounth to 130 inches near the headwater. The mean annual discharge for Hatchery Creek above the falls is 298 cubic feet per second. Although the shallow profile is the principle cause of the extended retention time other factors, including basin shape and area/elevation relationships, are relevant.

The area-elevation plot, as shown in Graph 2, indicates a large, low elevation catchment, i.e. fifty percent (50%) of the watershed is below 500 feet and only twenty-three percent (23%) is greater than 1,000 feet. This suggests that the high, steep slope that fringes the area and intercepts precipitation contributes less "quick flow" than assumed.

HYDROLOGY

The hydrologic investigation of Hatchery Creek was analyzed in two ways, the first used the S.E. Water Atlas, and second used field channel analysis. It should be noted that the graphs and equations from the water atlas are generated from a mathematical model. The graphic representations are plotted from a computer print out of values from the water atlas equations.

MONTHLY MEAN DISCHARGE

Monthly mean discharges are represented by the yearly hydrograph in Fig. 3, which characterizes the general hydrology of the drainage. This hydrograph is typical of the region in that the peak monthly discharges are in May and October, with a winter low in March and summer lows in July and August. For any indicated discharge, the flows are probably within the ninety percent (90%) confidence limits.

DESIGN FLOODS

Flood flows, based on drainage basin parameters, were generated for recurrence intervals of 2, 5, 10, 25, 50, and 100 years. The basic flood analysis in the model was based on a Log Pearson Type III Flood Frequency Analysis, Graph 4.

The maximum engineering design floor for fishway structures will be the 100 year event. At the falls in Hatchery Creek the 100 year event was calculated to be 5,375 cubic feet per second, with a range of 9,000 cubic feet per second for the high and 3,400 cubic feet per second for the low.

The flood delivery potential of this drainage is quite low with respect to its drainage area. This is a result of the low relief of the watershed and the numbers and sizes of the instream lakes.

The water atlas data was compared with values developed from the equation $Q_{50} + AH^{1/2}$ (Orsborn & Bartos, 1980) for the 50 year discharge. H is the relief in miles, A is the drainage area in square miles and Q_{50} is the 50 year flood discharge in cubic feet per second. The 50 year flood flow generated by this method is 6,400 cubic feet per second, compared to the S.E. Alaska Water Atlas value of only 5,000 cubic feet per second. However, the 6,400 cubic feet per second value still falls within the Atlas'ninety percent (90%) confidence interval for the indicated flows. The flow calculted for the 100 year flood would be 7,000 cubic feet per second, which is also within the confidence limits.

Minimum flows are split into two seasonal events, the 30 day summer and winter low flows and the 7 day summer and winter low flows at the 2, 5, and 10 year recurrence intervals. The summer low flows are the most critical in relation to operation of fishway at the times when the fish are utilizing the channel or structure. The low flows also limit the operation and efficiency of the structure's intake, especially during the critical 7 day low flows (Graph 5).

During critical low flow periods it is important that the estimated values are as accurate as possible. Below is a table comparing low flow values from the Atlas and from the Orsborn and Bartos relationship for various recurrence intervals.

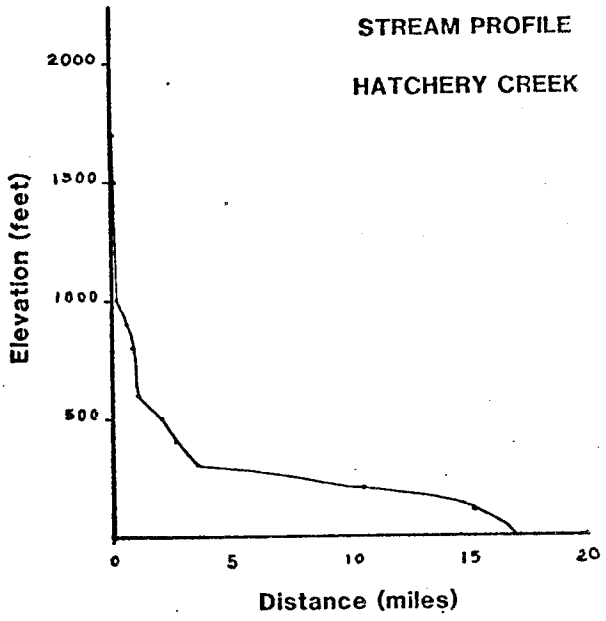
	Atlas		Orsborn & Bartos
Recurrence Interval	Q7L2		Q7L2
2	46	1/	25 c.f.s.
5	32		
10	25		
20			10 c.f.s.

1/ When the two values for the 7 day, 2 year recurrance interval for low flow discharge (Q7L2) are compared there is a 46% error, which is quite sizeable when dealing with a low flow situation. Since the Q7L2 derived from Osborn and Bartos, 1980 is developed from local data the low flow value is probably sounder than that of the Regional Water Atlas value for the Q7L2 discharge.

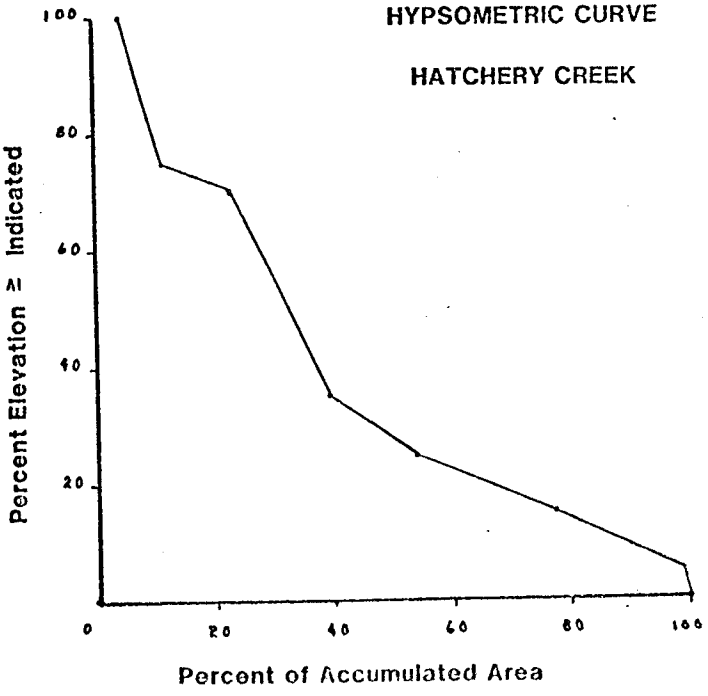
The mean annual discharge at the Hatchery Creek project site was calculated at 298 cubic feet per second, which, based on the yearly flow duration occurs 38% of the time. The median (50% of the time flow is equalled or exceeded) is 220 cfs which falls within the 90% confidence interaval of 210 -- 360 cfs, Graph 6. Considering construction periods within the most desirable flow stages that are discharges of 30 to 150 cfs only occur 22% of the time. Relating this to monthly time frames (Graph No. 3). The probable period for construction would be from the first of July to mid-August.

To determine the stages of water for different discharges, a curve was developed from topographic survey data above the falls. The analysis was generated from a slope-area analysis computer program developed by the author for the HP 9830A. The data on curve will be superseded by stage-discharge data from a gaging station to be established in the spring of 1981.

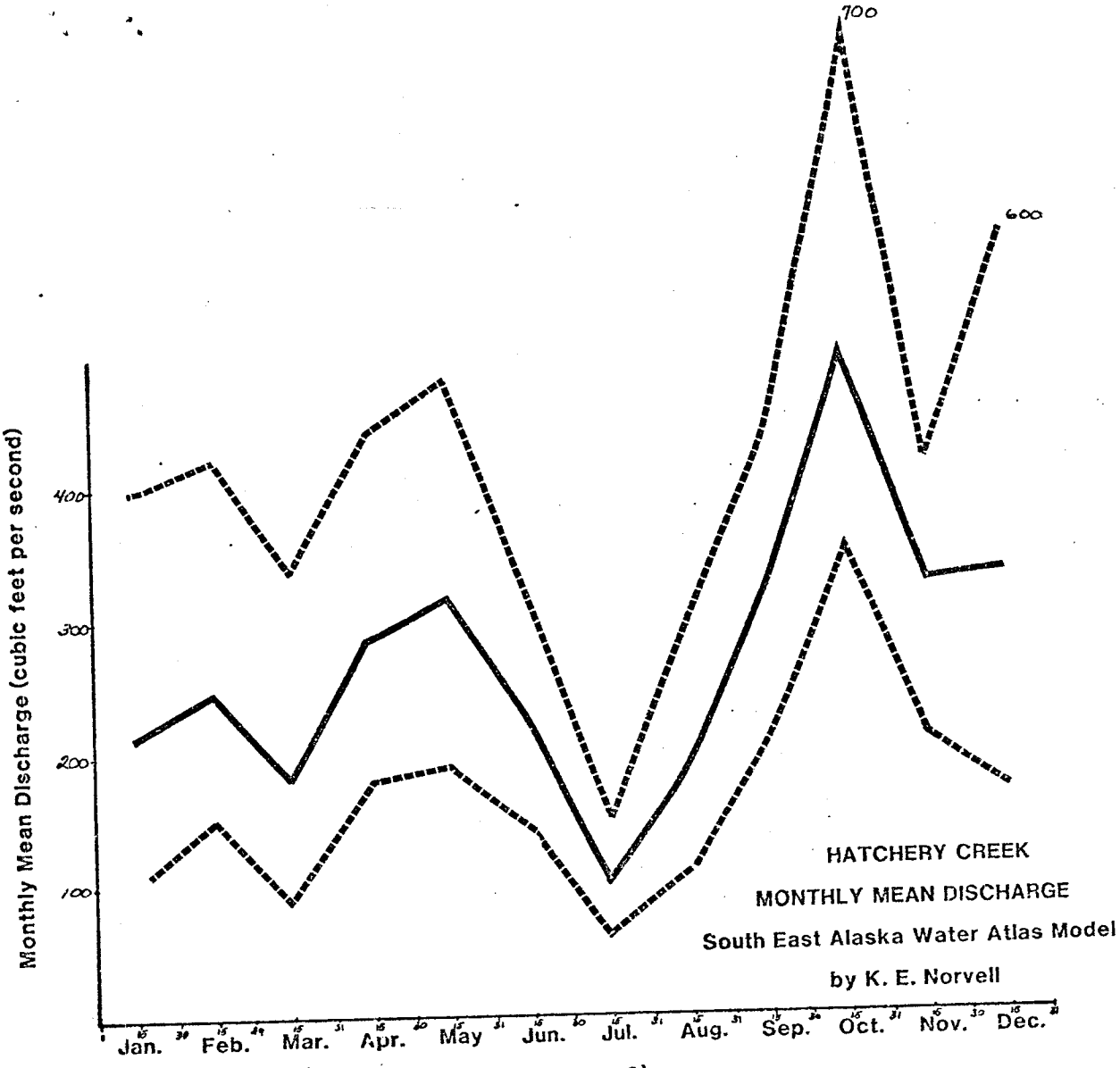
The data from the curve (Graph 7) can be used for feasability studies and designs, or lower level fish passage strucutural design. Until field verification can be made the preceding data should be used with discretion when developing a structural design or alteration.



(figure #1)



(figure #2)



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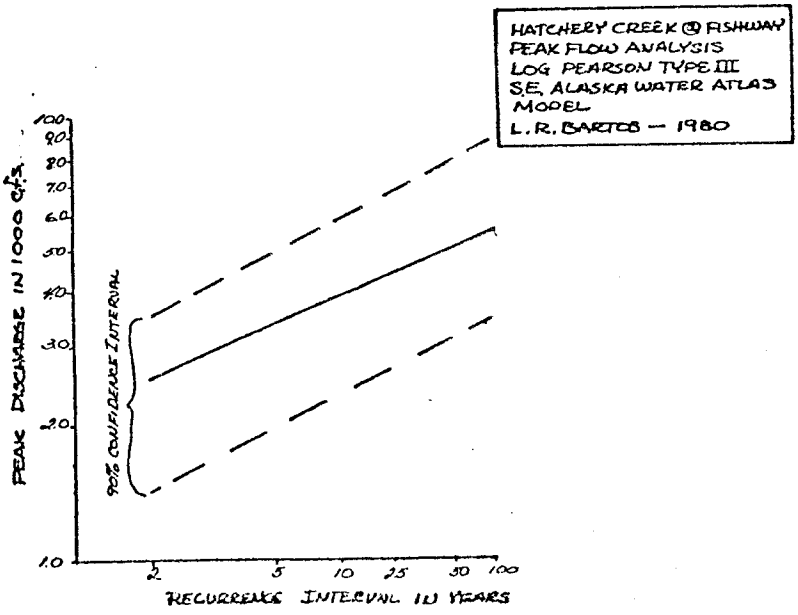
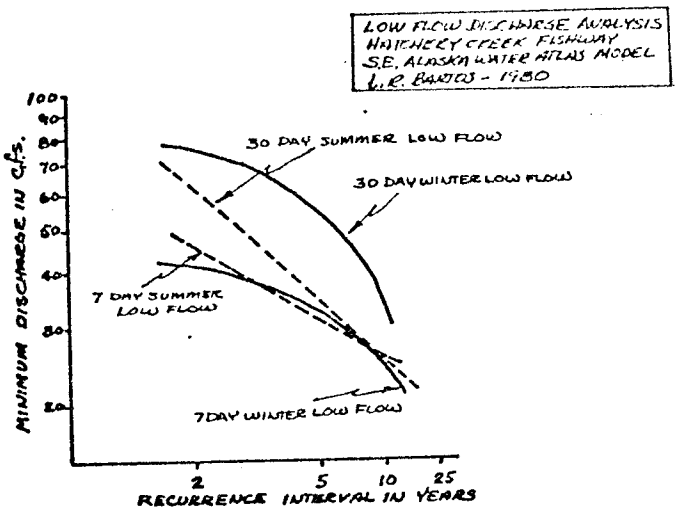
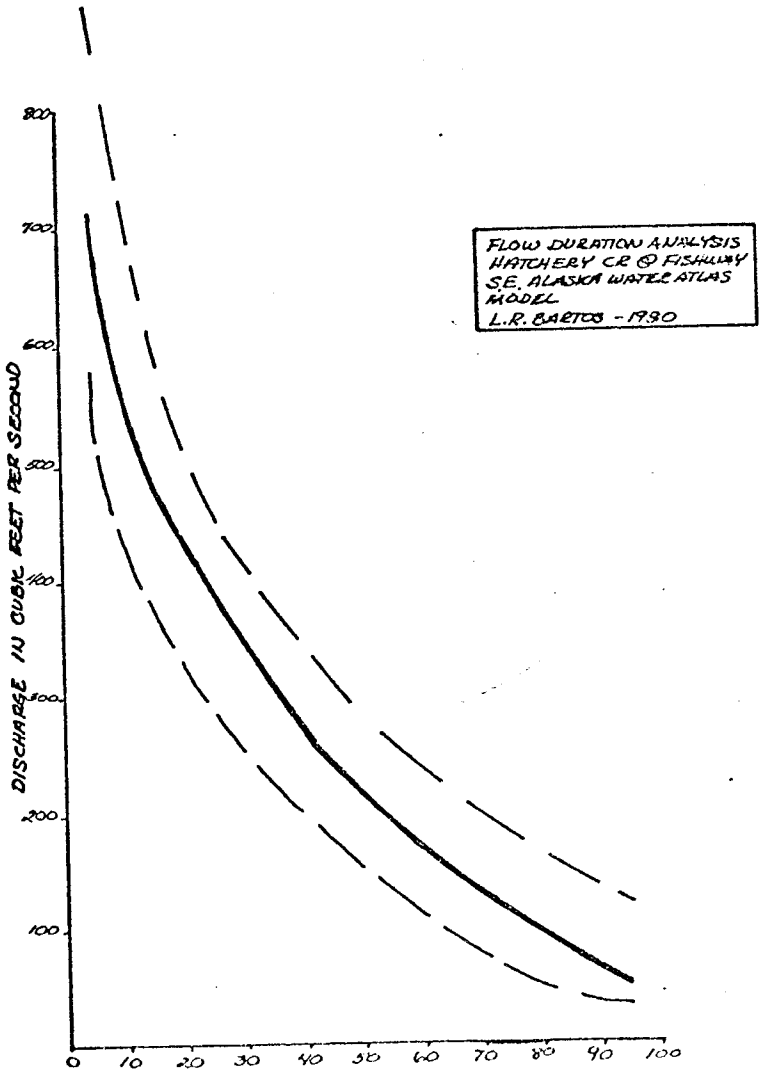


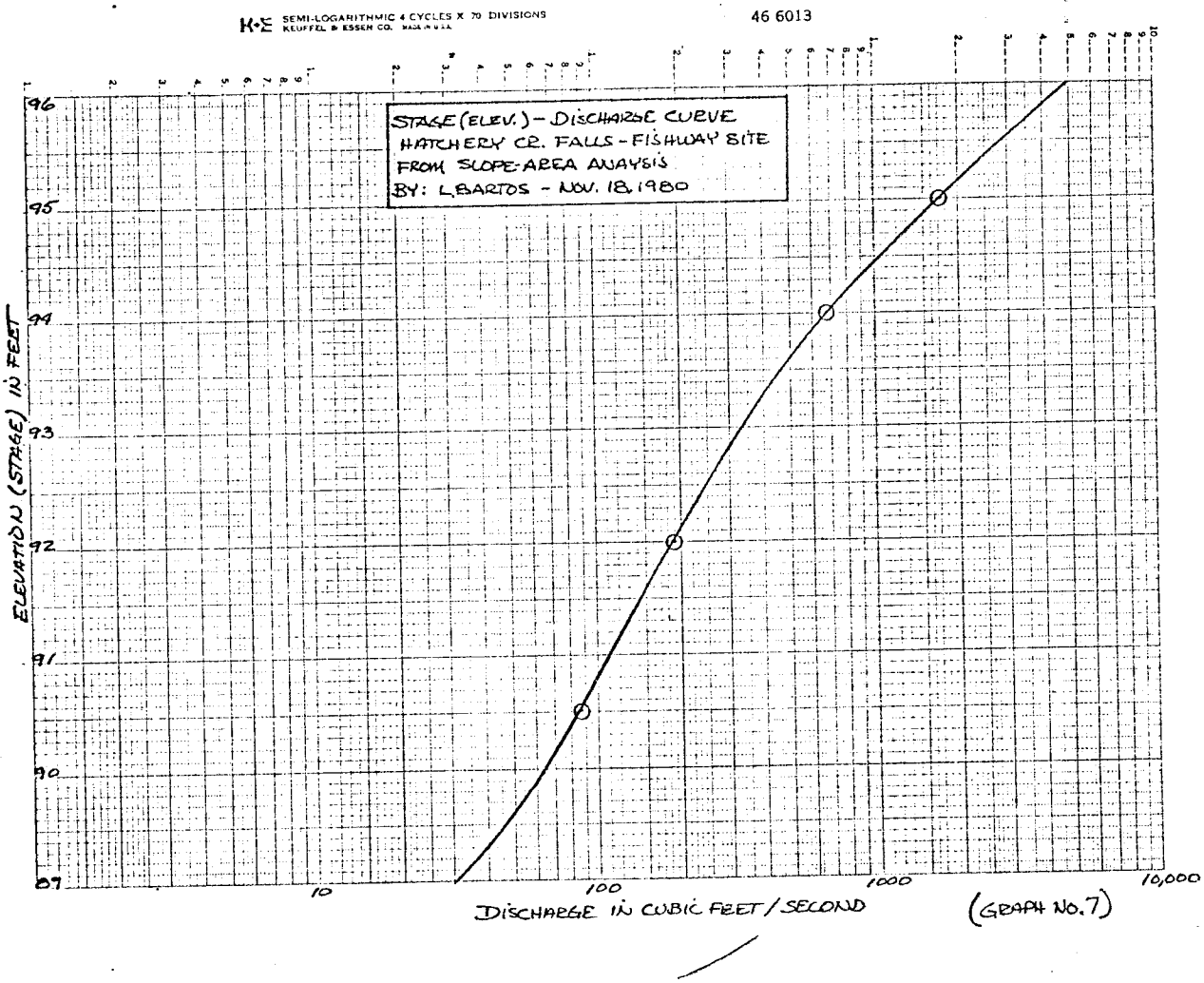
(FIGURE No. 4)



(FIG. 5)



(FISURE NO. 6)


K+E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSEN CO.
46 6013
STAGE (ELEV.) – DISCHARGE CURVE
HATCHERY CR. FALLS – FISHWAY SITE
FROM SLOPE-AREA ANAYSIS
BY: LBARTOS – NOV. 18, 1980
ELEVATION (STAGE) IN FEET
96
95
94
93
92
91
90
89
10
100
1000
10,000
DISCHARGE IN CUBIC FEET / SECOND

(GRAPH No. 7)

HATCHERY CREEK FISH ENHANCEMENT PROJECT

A. Introduction

The subsurface investigation of Hatchery Creek falls began on August 26, 1980, with a preliminary drilling program, and a geologic study. Data was collected to be used in the analysis and design of fish enhancement structures. During this field investigation, seven test holes were completed above the falls (Fig. 1). The drill could not be moved below the falls to complete the original drilling plan.

Additional site surveys were conducted to supplement the original survey, which was done several years ago. These were necessary to detail the flow conditions and topographic features at and below the falls.

B. Drilling Discussion

Drilling proceeded very slowly, as logistics prevented rapid repairs of the equipment, and frequent storms altered water conditions, which made movement between locations slow and hazardous. The drilling equipment used was inadequate to provide large diameter core samples for study, and therefore, much structural detail was inferred from drill notes (Appendices 1-7).

C. Geologic Field Study

The rock structure investigation was limited by infrequent visits to the site, and high water conditions. However; all major structures were identified and located.

D. Foundation Conditions at Site

Drilling indicates that at least 13 feet of overburden overlies the rock upstream from the site. At the falls, several shear zones bisect the rock at various angles forming wear zones from 2 to 3 feet in thickness which create topographic lows in the rock profile. At intersections of these discontinuities, larger sections have been removed by hydraulic activity, forming depressions, and overhangs in the rock.

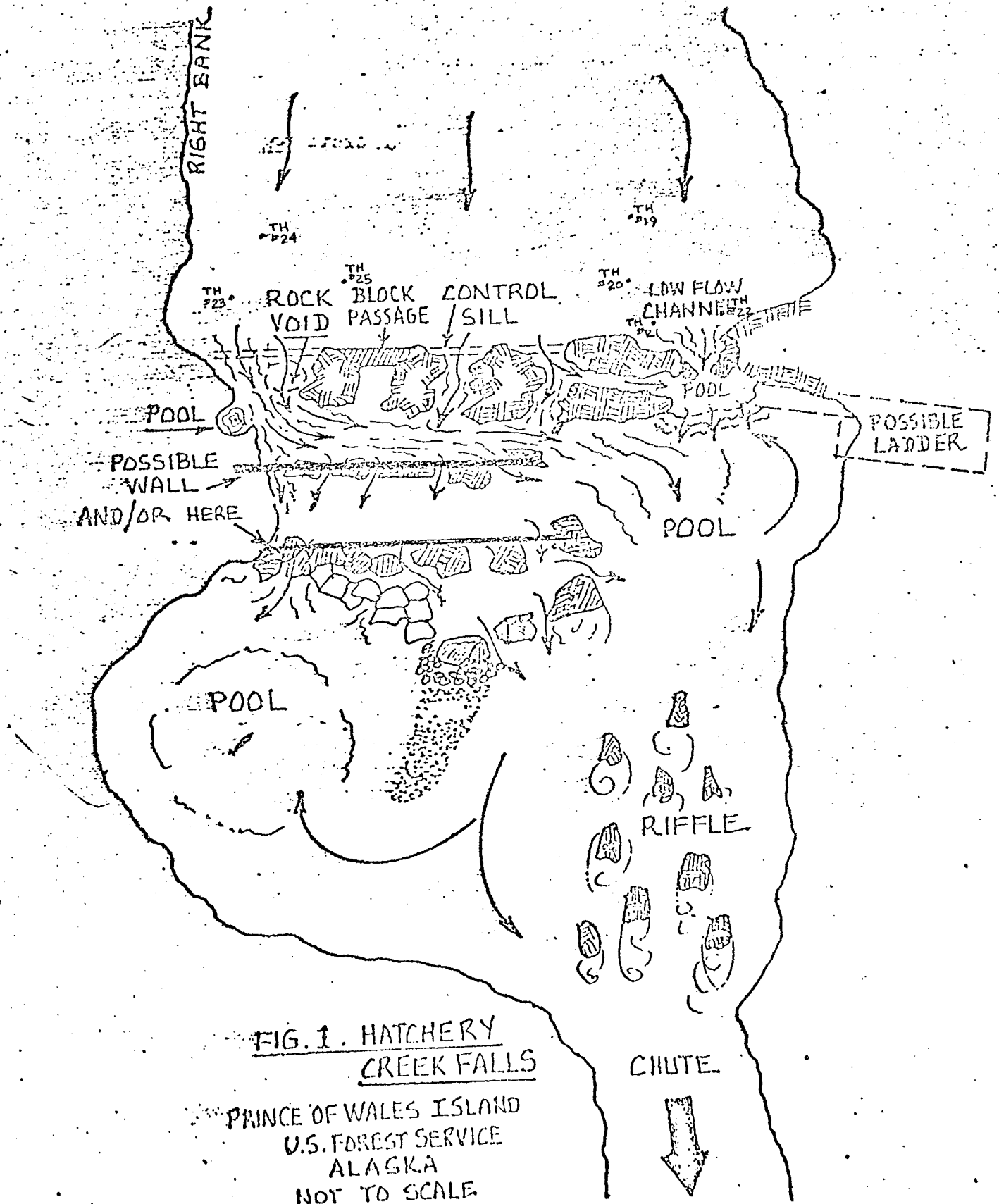


FIG. 1. HATCHERY CREEK FALLS

PRINCE OF WALES ISLAND
U.S. FOREST SERVICE
ALASKA
NOT TO SCALE
J.F. ORSBORN AUG. 9, 1980

Closely spaced joints and fractures are common throughout the rock. With minor exceptions, these will not affect the overall rock strength. It should be possible to install the low water control structure above the falls.

Below the falls, at the approximate location of the "possible ladder", bedrock was noted within a few feet of the surface, overlain by scattered cobbles and boulders. At 20 to 40 feet below the falls, on the left side looking downstream, bedrock forms the stream channel. The rock appears to be iron stained meta-volcanic on the surface with large inclusions and layers of white calcite. This plunge pool was probed to depths of 9 feet below the water surface on September 17, 1980.

On the right side below the falls, the rock ledges dip 20° to 30° in the upstream direction. One possible shear zone trends N. 30-40°E., dips 35° S.E., curving southerly to N. 20°E, with a 35° S.E. dip.

F. Design Considerations

The control sill will be possible to install with some rock grouting and rock bolt anchors but; will be subjected to rough treatment by logs at intermediate and high water flows (Fig. 1).

Rock is available for a foundation base for that portion of the "possible ladder" to be constructed below the falls. This portion of the structure will be protected by the rock outcrop directly upstream. At the fish outlet, it will be possible to modify the adjacent pool and "low flow channel" for the improvement of entrance flow conditions (Fig. 1).

The walls shown below the falls are evidently to enhance the high flow conditions (Fig. 1). These walls may not be stable during intermediate and high flows of logs and ice, and tend to direct the "attractive" current in the wrong direction during low to intermediate flows. These walls, at best, will be difficult to design. There is also the possibility that they may not last through the first ice and log laden high water flow.

Attachment

HATCHERY CREEK FISH ENHANCEMENT PROJECT

DRILLING

Drilling Equipment: All drilling was performed using an Acker "Ace" Core Drill, skid mounted, and placed on site by helicopter.

The casing ("BW" size, 2 7/8" outside diameter) was used to drill through overburden and/or very highly factured rock which would otherwise cave into the hole. Diamond casing bits were utilized. Core barrels used included; a 30 inch "BW" single tube core barrel with a core diameter of 1 5/8", a 30 inch "AW" single tube core barrel with a core diameter of 1 3/16", and a 60 inch swivel tube "AW" core barrel with a core diameter of 1 3/16". Diamond bits were used for all coring operations.

Core boxes are labeled and stored in Room 302.

USDA Forest Service
Northern Region

Sheet 1 of 1

ROCK DRILLING LOG

Forest Ketchikan Area Project [illegible] Location 98.0' to Sta.0+00 / 97.0' to " 0+33?
Date 8/26-27/80 Test Hole No. 1? Bit No. [illegible]
Driller Kelly Hole Location [illegible] Size Core [illegible]

Depth	Legend	Percent Core Recovery	Fracturing	Weathering	Materials Description—Rock Type, RQD Value, etc.	Sample No.	Drilling Time, Water Return, Pressure, Down Time, Driller's Comments, & general remarks
0–12.4'		0%	NA	NA	Silty, sandy gravel with cobbles from 0.0' to 12.4' Large cobble from 8.4' to 8.9' Soft silt from 8.9' to 9.0' Cobbles from 9.0' to 12.4'		B.W. Casing 8-24 1300-1340 @ 2.0' 1345-1420 @ 4.0' 1430-1455 @ 6.0' 1500-1515 @ 8.0' 1520-1550 @ 10.0' 1600-1615 @ 12.0' Rig readjusted @ 12.0' 8.4'-8.9' rock H_2O @ 100 PSI. Soft from 8.9'-9.0' H_2O @ 100 PSI to 12.0'
12.4'		19%	Highly Fract.	Mod.	In fractured rock from 12.4 to 14.0'		
15		0%			Highly fractured to 20.0'		BW Casing 8/27/80 1045-1150 @ 12.0' (Redrill) 1325-1417 @ 14.0'
		15%					BW Core Barrel, single tube 1443-1516 @ 15.5'
20	Bottom of Hole				Core Recovery @15.6' - 0.5' core, 1/2"-3" fractures, ave. = 1" @17.4' - zero recovery @20.0' - (0.4' core, 1/4" to 1" fractures, ave. = 1/2"		AW Swivel Tube 1552 to 1755 @ 20.0'

Log By: [illegible signature]

APPENDIX 2

USDA Forest Service
Northern Region

Sheet 1 of 1

ROCK DRILLING LOG

101.0' to 50+41.0+60.23
102.0' to 50+41.0+67.42

Forest KETCHIKAN AREA Project HATCHERY CR. Location

Date 8/25-27/80 Test Hole No. 2.0 Bit No. C50095

Driller NEAL Hole Location SEE MAP Size Core 4"

Depth	Legend	Percent Core Recovery	Fracturing	Weathering	Materials Description - Rock Type, RQD Value, etc.	Sample No.	Drilling Time, Water Return, Pressure, Down Time, Driller's Comments, & General remarks
0		0%	NA	NA	0.0' to 4.7', SILTY SANDY GRAVEL WITH COBBLES.		BW CASING 8-28 1138-1157 @ 1245-1338 @ 2.0' 1349-1439 @ 4.0' 1447-1555 @ 6.0' 1605-1630 @ 6.5'
5		62%	AV. 2"	MOD	4.7' to 5.0'. HIGHLY FRACTURED.		BW CORE BARREL 8-29 0900-0974 @ 6.5' 1034-1141 @ 7.9' 1158-1254 @ 10.4'
7.9		92%	AV. 3"		5.0' to 10.4' - MOD. FRACTURED		@ 7.9' - 1.8' CORE, FRACTURES 1/2" to 2", AVE. 2". @ 10.4' - 2.3' CORE, FRACTURES @ 1/2" to 6", AVE 3".
10		BOTTOM OF HOLE					
10.4							
15							

Log By: Robert Beckman

APPENDIX 3

USDA Forest Service
Northern Region

Sheet 1 of 1

ROCK DRILLING LOG

Forest KETCHIKAN AREA Project HATCHERY CR. Location _____
Date 9-24-84, 25 Test Hole No. 7-1 Bit No. 7450 C
Driller _____ Hole Location SEE MAP Size Core EW

Depth	Legend	Percent Core Recovery	Fracturing	Weathering	Materials Description- Rock Type, RQD Value, etc.	Sample No.	Drilling Time, Water Return, Pressure, Down Time, Driller's Comments, & General remarks
0.8		62%	1"-2"		0.0' to 0.8' - COBBLES AND GRAVEL WITH SILTY SAND.		B.W. CORE BARREL. SINGLE TUBE 9/3
		49%	1" to 12"		0.8' to 18.8' - ROCK; GRAY, IMPURE DOLOMITIC LIMESTONE WITH FREQUENT CALCITE VEINLETS AND SCATTERED PYRITE CRYSTALS.		0900-1030 @ 0.8'
5							1030-1100 @ 4.5'
6		85%	2" to 2½"				1115-1300 @ 4.5'
8		73%	2" to 3"				1315-1400 @ 8.0'
8½		67%	1"				1410-1430 @ 8.16' (BLOCK)
9½		100%	1"-3"				A.W SWIVEL TUBE
10		100%	1"-3"				1440 to 1600 @ 9.5 9/4
10½		83%	1" 2½"				0915-1114 @ 10.6'
11½		50%	½"-1"		NOTES		1148-1254 @ 11.5'
12½					@ 12.0 to 2.4' - SHEAR ZONE? HIGHLY FRACTURED, SILT IN WATER RETURN.		1309-1411 @ 12.3'
14½		70%	1"-3"				1432-1504 @ 14.8'
15		84%	1" to 4"				1512-1541 @ 17.3'
17½							1550-1627 @ 18.8'
18½		69%	1" to 2"		@ 8.0' ± POSSIBLE SHEAR ZONE		H2O PRESSURE 80-100 PSI, WATER RETURN GRAY TO WHITE.
		BOTTOM OF HOLE					
20							

Log By: [illegible]

APPENDIX 4

USDA Forest Service
Northern Region

Sheet 1 of 1

ROCK DRILLING LOG

Forest KETCHIKAN AREA Project HATCHERY CR Location _____
Date 9-5 to 10, 1980 Test Hole No. 2.7. Bit No. _____
Driller _____ Hole Location _____ Size Core _____

Depth	Legend	Percent Core Recovery	Fracturing	Weathering	Materials Description - Rock Type, RQD Value, etc.	Sample No.	Drilling Time, Water Return, Pressure, Down Time, Driller's Comments, & General remarks
0.0'							9/5/80
							MOVE IN
2.9'		60%	1½" to 2.0"		0.0' to 3.0' - GRAVEL AND HIGHLY FRACTURED ROCK.		9/8/80
4.0'		62%	1" - 2"				AW CORE BARREL
5.0'		21%	½" to 2"		3.0' to 8.5' - MODERATE TO HIGHLY FRACTURED ROCK.		1035-1051 @ 1.8' BROWN WATER RETURN - 0.9' CORE (GRAVEL?)
6.5'		85%	1" to 4"		THIN SILT FILLED FRACTURES @ 5.1' & 6.1' (BROWN WATER RETURN)		1132 to 1330 @ 2.6' GRAVEL?
8.5'		BOTTOM OF HOLE					LOST HOLE
10.0'							9/10/80
							BW CASE TO 3.5'
							BW CORE BARREL
							1055 to 1130 @ 3.2'
							1130 to 1230 &
							1515 to 1555 @ 4.0'
							(1230 to 1515 - H2O PUMP BREAKDOWN)
							AW CORE BARREL
							1605 to 1700 @ 6.5'
							9/11/80
							0900 to 1100 @ 8.5'

Log By:

APPENDIX 5

USDA Forest Service
Northern Region

Sheet 1 of 1

ROCK DRILLING LOG

Forest Kootenai Area Project Hanchey Co. Location _____
Date 9/12-15/80 Test Hole No. T-3 Bit No. _____
Driller _____ Hole Location _____ Size Core _____

Depth	Legend	Percent Core Recovery	Fracturing	Weathering	Materials Description - Rock Type, RQD Value, etc.	Sample No.	Drilling Time, Water Return, Pressure, Down Time, Driller's Comments, & General Remarks
0.9					0.0' to 0.9' - GRAVEL		9/12/80
		71%	2" to 3"		0.9' to 2.0' - HIGHLY FRACTURED ROCK		13 3/4 Case to 0.9'
3.6		100%	1" to 3"		2.0' to 15.0' - MOD. FRACTURED ROCK.		AW Core Barrel
5.4		83%	1" to 2½"				1010 to 1100 @ 3.6'
							BW Case to 4.0'
7.8		88%	1" to 2½"				1125 to 1225 @ 5.4'
10.3		85%	½" to 2"				1245 to 1330 @ 7.8'
11.6		79%	± 2"				1330 to 1350 @ 9.5'
14°		60%	1" to 2"				9/15/80
15°		Bottom	of Hole				0930 to 1000 @ 10.3'
							1005 to 1045 @ 11.6'
							1055 to 1140 @ 14.0'
							1150 to 1205 @ 15.0'

Log By: K. Hill

USDA Forest Service
Northern Region

Sheet 1 of 1

ROCK DRILLING LOG

Forest Ketchikan Area Project Discovery Cr. Location ____
Date 9-15 to 16-80 Test Hole No. 24 Bit No. ?
Driller [illegible] Hole Location [illegible] Size Core [illegible]

Depth	Legend	Percent Core Recovery	Fracturing	Weathering	Materials Description Rock Type, RQD Value, etc.	Sample No.	Drilling Time, Water Return, Pressure, Down Time, Driller's Comments, & general remarks
0 – 13.0 (5', 10')	o.o.o.	0%			0.0' to 13.0' - Over-burden GM. Silty gravel, some cobbles.		BW Case 9-15-80 1415 to 1645 @13.8' 9-16-80 BW Core Barrel 0930 to 1100 @15.5 1110 to 1200 @17.0 1210 to 1230 @18.0'
13.0 – 15.5		60%	1" to 2½"		13.0' to 18.0' - Moderately to highly fractured rock.		
15.5 – 17.0		60%	2"				
17.0 – 18.0		90%	1"-3"				
18.0	Bottom of hole						

Log By: [illegible]

APPENDIX 7

USDA Forest Service
Northern Region

Sheet 1 of 1

ROCK DRILLING LOG

FROM 0+23.52 = 72.4'
0+72.25 = 68.9'

Forest KETCHIKAN AREA Project HATCHERY CR. Location _____
Date 9/17/90 Test Hole No. 2-5 Bit No. 7
Driller [illegible] Hole Location [illegible] Size Core BW

Depth	Legend	Percent Core Recovery	Fracturing	Weathering	Materials Description — Rock Type, RQD Value, etc.	Sample No.	Drilling Time, Water Return, Pressure, Down Time, Driller's Comments, & general remarks
0'		0%		NA	0.0'-2.4' EST. 5% BOULDERS, AND 40% COBBLES, REST 50% SR-SA GRAVEL 40% SAND 10% SILT - 6M -		BW CASING 0932-1013 @ 2.2' 0923-0950 @ 2.6' RIG MOVED - JACK INTO POSITION
2.4'							
2.6'		87%	3/4" TO 3.5"	SLIGHT			BW CORE BARREL
3.2'					2.4' TO 8.5' - MODERATE TO HIGHLY FRACTURED ROCK.		1256-1310 @ 3.2' 1330-1408 @ 4.8' 1420-1434 @ 6.7'
5.0'		16%	3/4"				CAVED - @ 5.0'
6.7'		58%	3/4" TO 2 1/2"				1450-1507 @ 6.6' REDRILL
8.5'		100%	1" TO 2"				1515-1532 @ 8.5'
		BOTTOM OF HOLE					WATER RETURN GRAY TO 0.5' BROWN TO 0.7' GRAY & WHITE TO 8.5'
10.0'							N_2O PRESSURE @ 80-100 PSI

Log By: [illegible]